CHAPTER VI
WATER SYSTEM

610 WATER SYSTEM DESIGN

The following section is intended as a guide for the design, installation, and testing of water system improvements. All design, construction, testing, and maintenance, where applicable, shall conform to the latest adopted revision of the Oregon State Health Division Administrative Rules Chapter 333 on Public Water Systems except where the provisions herein exceed same. An approved water system capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings are to be constructed. The required fire flow must be available with a minimum residual pressure of 20 pounds per square inch (psi). Questions on required fire flow may be referred to the Fire Marshal's Office. The Engineer may request that modifications be made for a specific project. In general, the following guidelines should be followed:

A. All material shall be of new manufacture. No rebuilt, reconditioned, or used material will be allowed.

B. Minimum size mains shall be 6-inch, except that 4-inch may be permitted on runs less than 300 feet, when there will not be more than eight one inch services, where no fire hydrants are required, and when there is no possibility of future extensions.

C. Water mains will normally be located in accordance with City Standard Drawings.

D. Dead end mains normally shall not be allowed. When they are permitted, a blow off assembly will be required. In the event that the "dead end" finishes where there is risk of a vacuum being created due to water shut down, then a Combination Air and Vacuum Release Valve meeting City Standard Drawings requirements shall be installed.

E. Main extensions shall be installed through new developments to allow a logical extension of the City waterline grid and to allow future development of adjacent undeveloped or underdeveloped properties (*Beaverton Code* section 9.05.046).

F. Valves shall be located at intersections whenever possible. In general, sufficient valves should be provided to permit shutting down any section of the line, not exceeding 500 feet, with valve operations in not more than three locations.

G. Valves shall be installed in clusters at pipeline intersections. Valve boxes on all collector and arterial roads shall be Brooks No. 4-TT 10 ¼-inch diameter valve box with cast iron cover marked "Water." All other water valve boxes shall be Fort Vancouver 910 style.

H. Valves eight (8) inches and smaller shall be gate valves. Only resilient wedge gate valves shall be installed. Valves must meet AWWA C509 Standard for Resilient Seated Gate Valves. Valve body and bonnet shall be epoxy coated inside and out with fusion bonded epoxy. Coatings shall conform to AWWA C550 Standard Protective Coatings for Valves and Hydrants.

I. Valves ten (10) inches and greater shall be butterfly valves. All butterfly valves installed shall conform to AWWA C504 Standard for Rubber Seated Butterfly Valves. If a 10-inch or larger live tap is required, see section 615 for valve requirements at the tapping location. The preferred method will be to cut in a tee, however, the City Engineer and Operations Director may require a live tap due to shutdown disturbance.

J. Fire hydrants shall not be connected to mains less than six (6) inches in diameter. As per the *Uniform Fire Code*, fire hydrants shall be located to allow a 36-inch clear space surrounding the hydrant. For example, street lights, sign posts, protective posts, or retaining walls shall be no closer than 36 inches from the nearest portion of a hydrant. There shall also be no obstructions directly in line with any of the ports of the hydrant. The City accepts Clow F2500, Kennedy Guardian, Mueller, M & H Regent style 129I, and Waterous as approved in writing by the City Engineer prior to construction.

Fire hydrants supplied to this project must be selected from the following list. No other fire hydrants are acceptable for installation on this project.

1. Mueller, 3-way, 5-1/4 inch Super Centurion 200
2. Clow Medallion F-2545
3. Kennedy Guardian K-81D
4. Waterous Pacer WB67-250
5. M&H Regent Style 129

Fire hydrants shall be equipped with two 2-1/2 inch hose outlet nozzles and one 4-1/2 inch pumper outlet nozzle with threads conforming to NFPA 194 for National Standard Fire Hose Coupling Screw Threads. Minimum hydrant valve opening shall be 5-1/4 inches. The minimum hydrant branch line shall be 6-inches. The inlet connection to the base of the hydrants shall be 6-inches with end type as shown on the drawings or specified elsewhere in the specifications. Hydrants shall open to the left or counterclockwise. Hydrants shall be of the “break away” type to minimize breakage of hydrant parts in case of damage. The 4-1/2 inch port shall have a Storz quick adaptor.

K. Requirements for fire hydrant locations: (These criteria are subject to change. For the most current information, contact the Fire Marshal's office.)

1. Commercial Buildings: Fire hydrants shall be located so that no part of a commercial building is more than 250 feet from a fire hydrant measured along a route accessible to fire department vehicles. When a fire department connection (FDC) is installed in conjunction with an automatic sprinkler system, it is required to have a fire hydrant located within 70 feet of the FDC.

   Exception: When such buildings are protected with an approved automatic fire protection system, the Fire Marshal may allow variations from the 250-foot requirement up to a maximum of 500 feet measured along a route accessible to Fire Department vehicles.

2. Non-Commercial Buildings: Unless otherwise approved by the Fire Marshal, a fire hydrant shall be placed at each street intersection.

   Intermediate hydrants are required when the distances to any part of non-commercial buildings exceeds 500 feet measured along a route accessible to fire department vehicles.

For the purpose of 1. and 2. above, a 'commercial building' means a building used for other than R-3 or M occupancy as such occupancy is defined in *Beaverton Code* section 8.02.005 - 8.02.130. Specific location of fire hydrants requires the approval of the Fire Marshal.

L. For design of public water system improvements, system hydraulics must be analyzed using the worst-case scenario envisioned in the City's current *Water System Facility Plan*. The water system analysis shall be conducted using a simultaneous demand for the maximum (peak) day demand or peak hour non-fire demand, whichever is greater, and the fire demand. Parameters to be used to calculate non-fire demand shall be approved by the City. The fire demand shall be as specified by the Fire Marshal as applicable for the location, land use type, buildings contemplated and occupancy hazard.

All public water system improvements shall be designed to provide pressure within a range of no less than 50 pounds per square inch (psi) and not greater than 95 psi at peak demand (residual water system pressures at peak hour and peak day using network analysis modeling) excepting demand during fires. For practical application of the minimum 50 psi pressure requirement, a static pressure of 60 psi (theoretical pressure calculated from elevations or measured in the field) at non-peak times is required assuming a 10 psi drop during peak hour or peak day use. Exception may be granted or required by the City Engineer from the 95 psi maximum pressure for extenuating circumstances, including topography, water demand requirements, system configuration, and system operation. Water system improvements shall also be designed to operate during a fire, to provide a system pressure of no less than 20 psi with a simultaneous peak day non-fire demand. Required fire flow capacity of the public water system is to be designated by the Tualatin Valley Fire and Rescue Fire Marshal in conformance with the *Uniform Fire Code* adopted by the City of Beaverton.

If a water system flow test and analysis is required as a condition of approval, they are to be conducted by the developer under the supervision of the Engineer of Record for the project ("Engineer of Record"). This information in the past was provided by the City Fire Marshal's Office; however, because of past misinterpretations and misapplications of this data, it has been determined that this information must now be accompanied by supporting documents (requirements listed below) certified by a professional engineer registered in the State of Oregon, specifically for each project under their responsibility for design.

The following steps are to be performed by the engineer in order to conduct the flow test and water system analysis:

1. Applicant to comply with all Oregon Department of Environmental Quality (DEQ) rules and regulations regarding discharge of chlorinated water onto the ground and/or any public or private storm drainage system. Access DEQ's guidance on *Management Practices for the Disposal of Chlorinated Water* at: http://www.deq.state.or.us/wq/wqfact/DisposalofChlorinatedWater.pdf or contact DEQ at (503) 229-5292 for the current State statute and administrative rules.

2. A written request by the applicant/engineer to utilize the permit or written permission issued by the City must be submitted to the City Operations and Maintenance Water Distribution Supervisor, phone (503) 526-2646, fax (503) 526-2535, at least 48 hours prior to any flow test. Time and manpower requirements will be determined by the City's Water Distribution Supervisor.
3. Two stamped copies (by a registered professional engineer) of the test data and other relevant documentation are to be provided by the design engineer to the Development Services Division Project Engineer in the Community Development Department at Beaverton City Hall for review and evaluation. The documentation must include a determination by the engineer that the test data is representative of normal water system operating conditions and an interpretation of the data with respect to the hydraulic capacity of the City's water system, the pressure zone in which the test is taken, and the accuracy of the test results for purposes of the design.

M. Backflow devices, when required, shall be installed as per City Standard Drawings.

N. Pressure reducing devices are to be approved on a per project basis to ensure compliance with the *Uniform Plumbing Specialty Code*. Vaults for pressure reducing devices shall be in accordance with section 618 of this manual.

O. Water service size shall be evaluated by the Engineer and shall be of sufficient size that the requirements of 610.N. and 610.P. shall be met. Booster pumps shall not be allowed on meter service lines in order to meet this requirement. The meter size shall be no smaller than the service line size. At the discretion of the City Engineer, upon recommendation of the Operations and Maintenance Director, a smaller meter may be installed but in no event should the meter be more than one size smaller than the service line.

P. The Engineer shall provide a "pressure available" chart on the water system plan sheet of the construction plans; this sheet shall indicate the calculated pressures theoretically available to each lot during static and peak demand periods.

Q. Water service lines are to be single runs, minimum 1-inch diameter American or Canadian Type K copper pipe, from the main line to each meter. No yoked service lines will be allowed.

R. At high points in the water system, combination air and vacuum release valves (CARV) shall be installed as required by the City Engineer. All Air-Vac, Air Evacuation, and Vacuum Prevention Valves of sizes 2-inches and larger shall vent to the outside of the vault. If construction of the valve does not permit the venting of leakage to the outside of the vault, a screened drain to daylight of at least the supply line size must be provided at a level that will prevent cross connection and/or backflow problems. This decision will be made by the City Engineer prior to the plan approval.

S. Blowoffs are to be used at the end of cul-de-sacs and at the end of water lines that may be extended in the future. Blowoffs are to be not less than two (2) inches in diameter and sized at a minimum of 25 percent of the line diameter (see Standard Drawings).

611 MATERIALS

611.1 Water Pipes

Pipe shall be push-on joint ductile iron pipe except where specifically shown or detailed otherwise. Fitting joints shall be mechanical joint ends, except where specifically shown or detailed otherwise. Push-on joint ductile iron pipe shall be cement-mortar lined and conform to ANSI/AWWA C151/A 21.51 and ANSI A21.11. The type and thickness class shall be 52. The rubber ring gaskets shall conform to ANSI A21.11, be suitable for the specified pipe sizes and pressures, and shall be furnished with the pipe. A non-toxic vegetable soap lubricant shall be supplied with the pipe in sufficient quantities for installing the pipe furnished.

611.2 Pipe Fittings

A. Mechanical Joint Fittings: Mechanical joint cast iron fittings shall conform to ANSI/AWWA C104/A21.4 and shall be of class at least equal to that of the adjacent pipe. Mortar lining for fittings shall be the same thickness specified for pipe.

B. Flanged Cast Iron Fittings: Flanged fittings shall conform to ANSI B16.12 and shall be faced and drilled 125-pound ANSI. The fittings shall be cement-mortar lined to same thickness specified for pipe, and shall meet ANSI/AWWA C110/A21.11 for all other aspects.

C. Gaskets: Gasket material for flanged joints in cast iron pipe shall be cloth-inserted sheet rubber gaskets conforming to AWWA/ANSI C207/B16.21, 1/8-inch thick. The gasket shall be full-cut, with holes to pass bolts. Gasket material shall be free from corrosive alkali or acid ingredients.

D. Mechanical Couplings: Mechanical couplings, not a part of the pipe itself, shall be cast iron couplings with rubber rings and ductile iron bolts and nuts. Couplings shall be Dresser, Smith-Blair, or as approved in writing by the City Engineer.

611.3 Service Connections and Valves

Service connections and service valves shall meet the following requirements. In these requirements, the term “connection” refers to the outlet end of corporation stops, the inlet and outlet end of curb valves, the inlet of meter valves, and the inlet and outlet end of service fittings; the term “service valves” refers to corporation stops, curb valves/stops and meter valves/stops.

1. The service connection requirements herein are for copper tubing and pipe in sizes 3/4” to 2”.

2. Service fittings and connections shall be manufactured in accordance with the latest revision of AWWA C-800.

3. Service valves shall be "Mueller 300"® ball valves rated for 300-psi maximum working pressure or an equal product that is identical to Mueller 110® in configuration, materials, performance and all other respects except for external markings and labels, and shall be manufactured and tested in accordance with ANSI/AWWA Standard C800, with heavy brass components constructed of ASTM B62 (85-5-5-5) brass, lockwing accepting a bullet lock, double O-ring seals supported in precision machined grooves and providing secure, leak-tight sealing, with blow-out proof stem design, and with stainless steel reinforced seat O-ring, nitrile rubber seat, Fluorocarbon coated ball, valve nut composed of brass meeting applicable ASTM standards, with interior coated with Fluorocarbon to reduce torque resistance, and "Mueller 110®" end connections.

4. Service line connections shall be "Mueller 110®" Compression-type connection or an equal product that is identical to Mueller 110 in configuration, materials, performance and all other respects except for external markings and labels, and having the following characteristics. Compression fitting shall be designed and constructed to provide a positive metal to metal stop to prevent over tightening and provide a visual means to insure the connection is adequately tightened, with gasket that is a single piece assembly which includes stainless steel gripper band and the molded conductor spring. Gasket shall be composed of ASTM D2000 4AA815 molded synthetic rubber. The gripper band shall be identical to Mueller 110®, composed of hardened stainless steel, type 410. The entire width of the gripper band shall overlap after it is installed in the gasket to ensure maximum holding power. A stainless steel insert shall be provided for use with copper sized plastic tubing or iron pipe sized plastic pipe. The gaskets for copper tubing or copper tube sized pipe shall have a conductor spring composed of ASTM B134 alloy C26000 bronze wire.

5. Manufacturing tolerances and testing methods for ball valves/stops shall be equal to or better than Mueller 300® ball valves. Manufacturing tolerances and testing methods for connections shall be equal to or better than Mueller 110® compression connections.

6. Service fittings and connections shall be manufactured in accordance with the latest revision of AWWA C-800.

7. Service valves shall be "Mueller 300"® ball valves rated for 300-psi maximum working pressure or an equal product identical to Mueller 110® in configuration, materials, performance and all other respects except for external markings and labels, and shall be manufactured and tested in accordance with ANSI/AWWA Standard C800, with heavy brass components constructed of ASTM B62 (85-5-5-5) brass, lockwing accepting a bullet lock, double O-ring seals supported in precision machined grooves and providing secure, leak-tight sealing, with blow-out proof stem design, and

with stainless steel reinforced seat O-ring, nitrile rubber seat, Fluorocarbon coated ball, valve nut composed of brass meeting applicable ASTM standards, with interior coated with Fluorocarbon to reduce torque resistance, and "Mueller 110®" end connections.

8. Service line connections shall be "Mueller 110®" Compression-type connection or identical equal, i.e. an equal product that is materially and functionally identical to Mueller 110 in configuration, materials, performance and all other respects except for external markings and labels, and having the following characteristics: Compression fitting shall be designed and constructed to provide a positive metal to metal stop to prevent over tightening and provide a visual means to insure the connection is adequately tightened, with gasket that is a single piece assembly which includes stainless steel gripper band and the molded conductor spring;. Gasket shall be composed of ASTM D2000 4AA815 molded synthetic rubber. The gripper band shall be identical to Mueller 110®, composed of hardened stainless steel, type 410. The entire width of the gripper band shall overlap after it is installed in the gasket to ensure maximum holding power. A stainless steel insert shall be provided for use with copper sized plastic tubing or iron pipe sized plastic pipe. The gaskets for copper tubing or copper tube sized pipe shall have a conductor spring composed of ASTM B134 alloy C26000 bronze wire.

9. Manufacturing tolerances and testing methods for ball valves/stops shall be equal to or better than Mueller 300® ball valves. Manufacturing tolerances and testing methods for connections shall be equal to or better than Mueller 110® compression connections.

611.3.1 Approved Products and Acceptance of Warranties

Only approved service connections and service valves shall be provided and installed. All service connections and service valves shall be of approved material, properly installed and in good working order, safe for public use.

If, after backfilling any service connection(s) or service valve(s), the City finds that certification as described in sub-section 150.3.1 of this Manual was not provided beforehand, the City may ask the applicant to provide such certification , satisfactory to the City. If the applicant does not provide such certification within seven (7) calendar days, or the City finds evidence of excessive leakage or other compelling evidence of unacceptable service connection or service valve materials, and/or installation of same, the City may require the applicant to excavate said service connection(s) and/or service valve(s) for inspection and/or testing and restore the excavated area(s) afterwards.

611.4 Water Meter Boxes

A. General: All water meter boxes and covers furnished under this specification for the City of Beaverton shall be polymer concrete and shall comply with the provisions of this specification.

B. Water Meter Box and Cover Assemblies: Polymer concrete box and cover assemblies shall be polymer concrete material consisting of calcareous and siliceous stone, glass fibers and thermoset polyester resin and shall be manufactured by Armorcast Products Company. Boxes shall be manufactured to the dimensions and configurations shown on Armorcast's drawings using male and female molds. Covers shall be manufactured to the dimensions and configurations shown on Armorcast's drawings using matched die molds. The model numbers for the parts of the Armorcast meter boxes that the City requires for its three service connection sizes are listed in the table below.

Service Connection Size	**Part Description**	**Armorcast Part No.**
1" Services		
	10"x15"x12" Polymer Concrete Meter Box	A6001921X12
	10"X15" Polymer Concrete Cover W/ Drop-in Read Lid Cavity	A6001922TDQ
	5"x9" Polymer Concrete Cover Drop-In Read Lid	A6000487T
1 ½" & 2" Services		
	17"x30"x12" Polymer Concrete Meter Box	A6001640PCX12
	17"X30" Polymer Concrete Cover W/ Drop-in Read Lid Cavity	A6001947TDZ
	9"x14" Polymer Concrete Cover Drop-In Read Lid	A6000482T

C. Color: Meter boxes and covers shall be "concrete gray" in color.

D. Vertical Load Test: Polymer Concrete box and cover assembly shall withstand a vertical test load of 20,800 pounds (16,000 lb. plus 30% impact factor) load over a 10"x20"x1" thick steel plate centered on the cover area and backed with a 10"x20"x1/2" rubber plate. The test loading shall not cause any failure to the box or cover.

E. Chemical Resistance: Polymer concrete material shall be resistant to chemicals commonly found in the soil or in the operating environment. Polymer concrete material shall be tested in accordance with ASTM D-543. The polymer concrete material shall be

resistant to sunlight and any climatic condition and shall be tested in accordance with ASTM D-756, procedure "E".

F. Manufacturer: Meter boxes and covers shall be manufactured by Armorcast Products Company ("Armorcast"). Substitutions will be considered only if they are equal and virtually identical in all respects to the Armorcast models specified, they are dimensionally interchangeable with the Armorcast models specified, and they meet or exceed the 20,800 pound load rating of the Armorcast models specified.

612 PIPELINE INSTALLATION

A. The work necessary to excavate, bed, and backfill water pipelines shall conform to the requirements of sections 150, 155, 210, and Chapter VIII Standard Drawings.

B. Distributing Pipe: Distribute material on the job from the cars, trucks, or storage yard no faster than can be used to good advantage. In general, distribute no more than one week's supply of material in advance of the laying.

C. Handling Material: Provide and use proper implements, tools, and facilities for the safe and proper prosecution of the work. Lower all pipe, fittings, and appurtenances into the trench, piece by piece, by means of a crane, slings, or other suitable tools or equipment, in such a manner as to prevent damage or contamination to the pipeline materials and protective coatings and linings. Do not drop or dump pipeline materials into the trench.

D. Cleaning Pipe and Fittings: Remove all lumps, blisters, and excess coal-tar coating from the bell and spigot ends of each pipe. Wire brush the outside of the spigot and the inside of the bell and wipe clean, dry, and free from oil and grease before the pipe is laid. Wipe the ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of all dirt, grease, and foreign matter. Check interior of pipe for obstructions or debris and if found, remove from pipe.

E. Placing of the Pipe in the Trench: Do not allow foreign material to enter the pipe while it is being placed in the trench. If it is necessary to place pipe in such a manner that bedding material may enter pipe because of trench configuration or shoring detail, then the Engineer shall require tight woven canvas boots be used and removed when placing pipe.

F. Push-on Joint Pipe: After the first length of push-on joint pipe is installed in the trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement.

G. Cutting Pipe: Cut pipe for inserting valves, fittings, or closure pieces in a neat and clean manner without damaging the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Cut pipe with milling type cutter or saw. Do not flame cut.

H. Dressing Cut Ends: Dress cut ends of push-on joint pipe by beveling, as recommended by the manufacturer.

I. Bell End To Face Direction Of Laying: Unless otherwise directed, lay pipe with bell end facing in the direction of the laying. For lines on steep slopes, face bells upgrade only.

J. Installation of mechanical joint pipe shall be as specified in AWWA C111 Appendix A, including bolt torque ranges. Mechanical joint gaskets shall be vulcanized rubber and no more than three (3) years old.

K. All material shall be of new manufacture. No rebuilt or reconditioned material will be allowed.

L. Permissible Deflection of Joints: Wherever it is necessary to deflect pipe from a straight line either in a vertical or horizontal plane, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed the values in the following table:

MAXIMUM DEFLECTION PERMITTED*
18-Foot Length Pipe

	Mechanical Joint Maximum Deflection**		**Push on Joint Maximum Deflection**	
Diameter Inches	**Angle Degrees - Minutes**	**Deflection Inches**	**Angle Degrees**	**Deflection Inches**
4	8-18	31	5	19
6	7-07	27	5	19
8	5-21	20	5	19
10	5-21	20	5	19
12	5-21	20	5	19

*The maximum deflection shall be whichever is less, the table or that recommended by the pipe manufacturer.

**Safe deflection for 150 pounds pressure. For higher pressure, reduce tabulated deflection proportionally ten (10) percent for each 150 pounds added pressure.

M. Alignment: Pipelines intended to be straight shall not deviate from the straight line at any joint in excess of one inch horizontally or vertically.

N. Unsuitable Conditions for Laying Pipe: Do not lay pipe in water or when, in the opinion of the Engineer, trench conditions are unsuitable.

O. Joining Push-On Joint Pipe and Mechanical Joint Fittings: Lay and join pipe with push-on type joints in strict accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for the installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.

Mechanical joint fittings vary slightly with different manufacturers. Install the particular fittings furnished in accordance with the manufacturer's recommendations. In general, the procedure shall be as hereinafter specified. Clean the ends of the fittings of all dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip the gland and gasket on the plain end of the pipe. If necessary, lubricate the end of the pipe to facilitate sliding the gasket in place. Then guide the fitting onto the spigot of the pipe previously laid.

P. Anchorage and Thrust Blocking (See Standard Drawings): On all pipelines four (4) inches in diameter or larger, securely anchor by an engineered system of suitable mechanical joint

restraint devices and thrust blocking, all tees, plugs, caps, and bends exceeding 11 ¼ degrees, and at other locations where unbalanced forces exist, as determined by the Engineer and approved by the City Utilities Engineer. Restraint devices for mechanical joint pipe, fittings, and appurtenances shall conform to ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53 as applicable and consistent with City requirements.

Provide reaction or thrust blocking as directed. The concrete mix shall have a compressive strength of not less than 3,000 pounds per square inch. Place blocking between the undisturbed ground and the fitting to be anchored. The bearing surface shall be as shown on the Standard Drawing for thrust blocking. Place the blocking so that all pipe and fitting joints (new and existing) will be accessible to repairs. Replace any existing thrust blocks that have been disturbed with new thrust blocks meeting all City requirements.

Q. Downtime Protection: When stopping work for the day, the contractor shall plug pipe ends to prevent rodents, other small animals, or debris from entering the pipe. Plugs used shall be watertight when submerged up to fifteen (15) feet.

613 HYDROSTATIC TEST OF NEWLY INSTALLED WATERLINE

The contractor shall make pressure and leakage tests on all newly laid pipe, including mainline pipe, valves, blowoffs, fire hydrant and other appurtenances. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The Engineer will monitor the tests. The Engineer shall also indicate that the thrusting blocks have obtained the needed strength to resist the pressures obtained during the hydrostatic test. The contractor shall furnish the following equipment and materials of the tests:

Amount	**Description**
2	Approved graduated containers.
2	Pressure gauges (maximum 2 psi increments).
1	Hydraulic force pump approved by the Engineer.
	Suitable hose and additional equipment as required.

Conduct the tests after the trench has been backfilled. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure tests until at least five days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut by two days or as permitted by the Engineer.

Conduct pressure tests in the following manner, unless otherwise approved by the Engineer. After the trench has been backfilled or partially backfilled as specified herein, fill the pipe with water, expelling all air during the filling. The minimum test pressure shall be 150 pounds per square inch (psi). For lines working with operating pressures in excess of 100 psi, the minimum test pressure shall be one and one-half times the operating pressure, with the same loss allowances.

A. Duration: The duration of each pressure test shall be 60 minutes, unless otherwise directed by the Engineer.

B. Fill the pipe with water and apply the specified test pressure by pumping, if necessary. Then valve off the pump and hold the pressure in the line for the test period. At the end of the test period, operate the pump until the test pressure is again attained. If the line pressure drops more than five (5) psi during the test, repeat the test (again for 60 minutes each time) until the drop in line pressure is five (5) psi or less, and then measure the leakage amount. The pump suction shall be in a clean barrel or similar device approved prior to filling with clean water, or metered so that the amount of water required to restore the test pressure may be measured accurately.

C. Leakage: Leakage shall be defined as the quantity of water necessary to restore the specified test pressure at the end of the test period. No pipe installation will be accepted if the leakage corresponding to a pressure drop of 5 psi or less is greater than one-half the number of gallons per hour calculated by the following formula:

$$L = \frac{SD\ (\sqrt{P})}{133\ ,200}$$

In the above formula: L = Allowable leakage, in gallons per hour for a 2-hour test.
S = Length of pipe to be tested.
D = Nominal diameter of pipe, in inches.
P = Average test pressure during the leakage test, in pounds per square inch.

Therefore, the maximum amount of leakage allowed by the City is equal to 0.5L.

D. Correction of Excessive Leakage: Should any test of pipe laid exhibit leakage greater than that allowed or a loss in pressure greater that five (5) psi during the pressure test, locate and repair the defective joints, pipe or other leaking water system component(s) until the leakage and pressure loss of a subsequent test are within the specified allowance.

E. Isolation of existing systems prior to testing: Existing water pipelines shall be protected from contamination during the testing process for new construction. Use of special "blind flanges" will be necessary if the line being tested cannot be adequately separated from existing systems. The Engineer shall submit shop drawings and proposed procedures to the City prior to installing any special testing device.

614 STERILIZATION OF NEWLY INSTALLED WATERLINE

Pipeline intended to carry potable water shall be sterilized before placing in service. Sterilizing procedures shall conform to AWWA C-651 as hereinafter modified or expanded.

A. Flushing: Before sterilizing, flush all foreign matter from the pipeline. Provide hoses, temporary pipes, ditches, etc. as required to dispose of flushing water without damage to adjacent properties. Disposal site and method shall be approved by the City Engineer prior to use. Flushing velocities shall be at least 2.5 feet per second (fps). For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps, clean the pipeline in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

B. Sterilizing Mixture: Sterilizing mixture shall be chlorine-water solution having a free chlorine residual of 40-50 ppm. The sterilizing mixture shall be prepared by injecting (1) a liquid chlorine mixture, or (2) a calcium hypo chlorite or sodium hypo chlorite and water mixture into the pipeline at a measured rate while fresh water is allowed to flow through the pipeline at a measured rate so that the chlorine-water solution is of the specified strength. See the following chart for a guideline to mixing the chlorine-water solution:

CHLORINE-WATER CONCENTRATION CHART
(Guideline Only)

PIPE SIZE (INCHES)	GALLONS PER 100 FOOT LENGTH	AMOUNT REQUIRED TO GIVE 50 PPM CI PER 100 FEET OF PIPE LENGTH				
		A	B	C	D	E
4	65.3	0.028 LB	0.04 LB	0.08 LB	0.06 GAL	0.02 GAL
6	146.5	0.062 LB	0.10 LB	0.18 LB	0.14 GAL	0.04 GAL
8	261.0	0.108 LB	0.16 LB	0.32 LB	0.24 GAL	0.08 GAL
10	408.0	0.170 LB	0.24 LB	0.48 LB	0.38 GAL	0.14 GAL
12	558.7	0.240 LB	0.36 LB	0.70 LB	0.56 GAL	0.20 GAL

A - 100 percent Chlorine
B - High Test Calcium/Sodium Hypochlorite (65-70% Cl)
C - Chlorinated Lime (32-35 percent Cl)
D - Liquid Laundry Bleach (5.25 percent Cl)
E - Concentrated Liquid Bleach (15 percent Cl)

The liquid chlorine gas-water mixture shall be applied by means of an approved solution feeding chlorination device. Dry chlorine gas shall be fed through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine or the gas itself must provide means for preventing the backflow of water into the chlorine cylinder.

If the calcium hypo chlorite procedure is used, first mix the dry powder with water to make a thick paste, then thin to approximately a one percent solution (10,000 ppm chlorine). If the sodium hypo chlorite procedure is used, dilute the liquid with water to

obtain a one percent solution. The following proportions of hypo chlorite to water will be required.

Product	Quantity	Water
Calcium Hypo chlorite (1) (65-70 percent Cl)	1 lb.	7.5 gal.
Sodium Hypo chlorite (2) (5.25 percent Cl)	1 gal.	4.25 gal.

1. Comparable to commercial products known as HTH, perchloron, and pittchlor.
2. Known as liquid laundry bleach, Clorox, Purex.

C. Point of Application: Inject the chlorine mixture into the pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of the pipeline within three (3) feet of the water source filling the line. Water from the existing system or other approved source shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The rate of chlorine mixture flow shall be in such proportion to the rate of water entering the pipe that the combined mixture shall contain 40-50 ppm of free available chlorine. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check valves if necessary. At no time will dry chlorine be introduced into the pipeline.

D. Retention Period: Treated water shall be retained in the pipeline long enough to destroy all nonspore-forming bacteria. With proper flushing and the specified solution strength, 24 hours is adequate. At the end of the 24-hour period, the sterilizing mixture shall have a strength of at least ten (10) ppm of chlorine.

Operate all valves, hydrants, and other appurtenances during sterilization to assure that the sterilizing mixture is dispersed into all parts of the line, including dead ends, new services, and similar areas that otherwise may not receive the treated water.

Do not place the concentrated quantities of commercial sterilizer in the line before it is filled with water.

After chlorination, flush the water from the line until the water through the line is equal chemically and bacteriologically to the permanent source of supply. Under no circumstance shall pressure testing occur while chlorine solution is in the line.

E. Disposal of Sterilizing Water: Dispose of sterilizing water in an approved manner. Do not allow sterilizing water to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine to a safe level. Dechlorinization procedures are to be submitted in writing and approved by the City Project Engineer prior to flushing system.

615 TAPPING

All tapping of four (4) inch and larger public water pipe shall be performed using an all stainless steel tapping sleeve - JCM 432.

If a live tap is required in order to extend a line over ten (10) inches in diameter, and the maximum design pressure is less than 75 psi, a gate valve will be allowed with no butterfly valve. If the maximum design pressure is over 75 psi, a butterfly valve will be required to be directly bolted to the gate valve. All valves shall be installed with valve boxes and lids per City standards.

Prior to tapping, all items that may come in contact with the public water shall be swabbed with a 300 mg/L chlorine solution. The following items shall be the minimum items swabbed: tapping machine bit and cutter, tapping valve, tapping sleeve, and the exterior section of pipe to be tapped after the pipe has been cleaned with a wire brush (to be extended a minimum of six (6) inches outside the tapping area).

616 SAMPLING STATION

All sampling stations shall be Eclipse Number 88. The sampling station shall have a ¾- inch FIP inlet, and a ¾-inch hose nozzle. All stations shall be enclosed in a lockable, non-removable, aluminum-cast housing. When opened, the station shall require no key for operation, and the water will flow in an all-brass waterway. All working parts will also be of brass and be removable from above ground with no digging. A copper vent tube (standard) will enable the station to be pumped free of standing water to prevent freezing and to minimize bacteria growth. The exterior piping will be brass, and a ¼-inch ball valve shall be provided in place of the ¼-inch pet cock on the vent pipe.

617 CROSS CONNECTION CONTROL AND BACKFLOW ASSEMBLIES

617.1 General

Cross connection control and backflow assemblies shall conform to the requirements of this section and the Standard Drawings. An approved backflow prevention assembly is required on all fireline systems, domestic water service larger than two (2) inches, and/or a structure having water supply fixtures that could result in a standing water in excess of 30 feet above the water main, in accordance with *Beaverton Code* section 4.02.160, this manual, and all backflow prevention requirements of the City Utilities Engineer or the applicable water provider. It is the design engineer's responsibility to select the proper backflow prevention assembly and vault and to include the proper City Standard Drawings for them in the detail sheets provided with both site development permit and site plumbing permit application plan sets as applicable for the particular circumstances. The design engineer is also responsible for

coordinating selection of the proper backflow prevention assembly and vault design with the owner, architect, contractor and City plumbing inspector.

If, after the City's initial approval, there is a change in the building's intended use or other factors that requires an alternative backflow prevention design, it is the design engineer's responsibility to select an alternative backflow prevention assembly and vault as required to reflect the change, and to submit new detail drawings for review and approval by the City Utilities Engineer or applicable water provider prior to submittal to the City Building Division for plumbing permit issuance and, as applicable, reflect any such changes to the private plumbing system in the "as-builts" of a site development permit. City approval of plans and detail drawings within a site development permit plan set is not formal approval of the private backflow prevention assemblies and vaults in said plan set, which are governed by the Oregon Administrative Rules Chapter 333, the UPC and the NFPA rules governing backflow prevention. Rather, the formal plan approval for backflow prevention assemblies and vaults occurs only with the issuance of a Plan Review Letter by the Building Division, which can only be issued upon the Building Division's receipt of written approval of the backflow assemblies and vaults from the City Utilities Engineer or the applicable water provider through the City Utilities Engineer. Further, City approval of plans and detail drawings within a site development permit plan set does not relieve the design engineer of any of the aforementioned responsibilities.

The assembly shall be installed at the location normally established for water meters, usually at the property line. A water service shall not be turned on until all required backflow prevention assemblies are installed, inspected, tested, approved, and registered with the City of Beaverton. Costs of all installations, including all costs of inspection and testing fees, shall be the responsibility of the customer. The backflow prevention assembly will remain the property of the customer. The customer will be responsible for all maintenance and testing of the assembly and vault.

When required, backflow prevention assemblies for protection of the public water system shall meet the requirements set forth in the current Oregon Administrative Rules Chapter 333-61-070, *Uniform Plumbing Code*, and *Beaverton Code* section 4.02.160 and section 4.02.165.

617.2 Types of Backflow Prevention Assemblies

There are three types of backflow prevention assemblies that the City will allow as protection of the public water system. The Oregon Health Services Division, Drinking Water Section, provides a list of approved assemblies.

The type of backflow prevention assembly that is required is determined by the aforementioned rules and codes, based on the type of premises to which water service is being provided. The approved types of assemblies are listed below with some of the types of premises that must be protected by each type of assembly. However, these lists are not complete. They are only intended to give some basic guidelines.

A. Reduced Pressure Backflow Assembly: An approved Reduced Pressure Backflow Assembly shall be installed above ground on the service connection to the following premises:

1. Any tax lot that has an auxiliary water supply on or available to it. This will include any above or below ground water source. (The most commonly encountered type of auxiliary water supply is a private well.)

2. Commercial buildings that are located within an industrial zone.

3. Hospitals, medical centers, and clinics.

4. Mortuaries and nursing homes.

5. Gas stations.

6. Sewage pump and lift stations.

7. Dry cleaners and commercial laundries.

8. Any water system that has a pump to supplement pressure.

9. Irrigation systems that are designed to use chemical injection.

10. Any fire system that is designed or required to use a chemical solution within the piping (such as an antifreeze loop fire sprinkler system).

The above list may change from time to time and it is the design engineer's responsibility to ensure that the latest version of the list is consulted.

B. Double Check Assembly or Double Detector Check Assembly: An approved double check assembly or an approved double detector check assembly shall be required (provided that all internal plumbing is installed and maintained in accordance with the *Uniform Plumbing Code*), on the service connection to premises where there is:

1. Any fire system or water line to a private fire hydrant.

2. Multi-story buildings which are in excess of 30 feet above the water main at the service connection.

3. Shopping centers or large retail stores.

4. Restaurants or fast food establishments.

5. Any tax lot that is served by two water services supplied by the City.

6. Any water service that is larger than two inches in diameter.

The above list may change from time to time and it is the design engineer's responsibility to ensure that the latest version of the list is consulted.

After installation, all backflow prevention assemblies that are installed must be tested upon installation by a State of Oregon certified tester in accordance with *Beaverton Code* section 4.02.165. The results of the testing shall be received by the City prior to issuance of "final occupancy."

617.3 Location of Backflow Prevention Assemblies and Vaults/Boxes

Backflow assemblies shall be installed in vaults or boxes, as applicable, in accordance with this section, section 618, and the Standard Drawings.

Backflow prevention assemblies two (2) inches and smaller and their boxes shall be installed:

- At the water meter, which is usually at the property line, unless an alternative location for the assembly away from but near the meter, is approved by the City Utilities Engineer or applicable water provider, and

- On the customer side of the meter.

Backflow prevention assemblies larger than two (2) inches shall be installed entirely on private property, in a vault or in the building to be served if the main water line is within 20 feet of said building, and at a location approved by the City Utilities Engineer or applicable water provider, as appropriate to the design of the premises to be served.

617.4 Installation and Testing of Backflow Prevention Assemblies

Backflow prevention assemblies shall be tested promptly:

A. Upon installation, all backflow prevention assemblies must be tested by a State of Oregon Certified Backflow Assembly Tester in accordance with *Beaverton Code* section 4.02.165. A "final certificate of occupancy" shall not be issued for the premises served until the results of the testing have been received and approved by the City Utilities Engineer.

B. One year after installation and annually thereafter, as required by state law.

C. After any repair of the assembly.

D. Any time the assembly has been moved.

618 REQUIREMENTS FOR WATER SYSTEM VAULT INSTALLATIONS

618.1 General

Vaults for water meters, PRVs, backflow devices and assemblies, fire services, and combination air and vacuum release valves, and vaults' appurtenances including but not limited to ladders, access doors, sump pumps, and drains, shall conform to the requirements of section 618, and the Standard Drawings for water vaults.

A. The vault shall be sealed with Crystal Seal on the outside of the vault. Vault penetrations shall be sealed with non-shrink grout from the outside. Apply waterproof coating over grout. Backfill around vault per the manufacturer's specifications.

B. Access into the vault shall be through a standard Bilco door per the Standard Drawings. All Bilco doors on any public vault in the public right-of-way shall be structurally adequate for an H-20 loading. If any public or private vault is within a parking or maneuvering area (including the travel lane of any pubic or private street), the engineer shall evaluate the specific loading conditions and specify the proper door for those loading conditions. The engineer's evaluation and recommended lid design shall be submitted to the City Utilities Engineer for review and approval prior to submittal to the City Building Division for plumbing permit issuance.

C. Provide approved ladder if the vault or chamber depth is five (5)-foot - 0-inches or greater and entry is through the vault or chamber roof. Provide approved ladder extension meeting OSHA requirements as required by City, state, and federal standards.

D. Adequate drainage that prevents water from accumulating on the vault or chamber floor shall be provided for the vault or chamber. Trapped water in the vault shall be drained to daylight by gravity or pump, in conformance with the *Uniform Plumbing Code*. In no case shall the drainage be connected to a piped sanitary or storm water system. If a sump pump is used, the pump shall be capable of removing accumulated water at a minimum rate of five (5) gallons per minute (GPM) from the vault. The pump shall be equipped with an automatic flow switch; the pump and all wiring shall conform to the *National Electrical Code*.

E. Vault must be equipped with a moisture proof light fixture if adequate lighting is not available.

F. Vault is to have no other use, except for use described by these standards.

G. Vault shall be installed on undisturbed base or compacted ¾ - 0 inch gravel base.

H. No piping shall be installed in excess of three (3) feet above the vault floor.

I. Assembly is to be adequately supported from the floor, and suitably restrained from movement. Supports shall consist of steel supports; no wood supports shall be used.

J. All electrical wiring shall be inspected by the City of Beaverton Electrical Inspector (permit is required). Engineer to obtain copy of final electrical inspection from the contractor and submit it to the City along with his daily inspection reports.

K. The assembly shall be readily accessible with adequate room for maintenance.

L. All new services are to be pressure tested and disinfected by the contractor and proven to be bacteriologically safe from the existing main to the vault.

618.2 Backflow Prevention Device Assembly Vaults

Backflow prevention device assembly vaults shall be constructed in accordance with subsections 617.3 and 618.1 and the Standard Drawings.

618.3 Fire Services and Domestic Services

A. No part of the backflow prevention assembly shall be submerged in water or installed in a location subject to flooding. In a vault or chamber, adequate drainage shall be provided and test cocks shall be plugged. The plugs shall not be of dissimilar metals.

B. The backflow assembly shall be protected from freezing and other severe weather conditions.

C. All backflow assemblies shall have a minimum 12-inch clearance on the backside, 24-inch clearance on the test-cock side, and 12 inches below the assembly. Adequate clearance (three (3) inches minimum) must be maintained above gate-valve stem at full extension. Headroom of six (6) feet, 0 inches is required in vaults without a full opening top. Access to the device and to any vault or chamber shall remain clear at all times.

618.4 Water Meter Vaults

A. The vault is to be provided and installed by the contractor per City Standard Drawings.

B. The contractor shall provide a meter size uni-flange on the inside of the vault six (6) inches from the wall on the inside of the vault on the incoming (upstream) side. The City will install the meter, bypass, valves, and tees. The contractor will then provide the other flange and exit the vault.

618.5 Pressure Reducing Valve Vaults

The City Water Division shall provide consultation for the design of each proposed pressure reducing valve vault installation. Contact the City Water Division for assistance. All pressure reducing valve vaults shall be constructed per the Standard Drawings unless otherwise approved by the City Engineer.

619 Special Requirements for Fire Service Only

A. Fire Service backflow prevention assemblies shall be installed at the property line or edge of the public water line easement. The fire service from the public main to the backflow assembly shall be privately owned and meet all City Water System Standards as outlined in this Chapter. The delineation between the public and private line shall occur as close to the public main as possible and delineated with an in line public valve as defined in section 610. A backflow prevention assembly for a fire service line may be installed inside of a building if the "developed length," as defined in the Uniform Plumbing Code, between the backflow prevention assembly and the mainline source valve is twenty feet or less.

B. Only approved resilient seat indicating valves are allowed on fire line assemblies.

C. Only approved Double Detector Check Valve Assemblies are to be used for system containment on fire line services in the City of Beaverton. The meter on the bypass assembly shall read in cubic feet.

D. Fire Line Flow and Tamper Switches installed, as required by UBC sec. 3803, must be connected to a monitored Fire Detection System approved by the Fire Marshal. The tamper switches are required on the OS and Y gate valves in the vault, as well as any other indicating control valves on the fire protection system. Electrical inspection and permit is required.

E. The remote reader (if allowed) shall be rigidly mounted on an exterior building wall (near the domestic meter), enclosed in a metal box with a slot opening which allows reading the remote without opening the box, and at an elevation of five (5) feet above the ground level.

   The remote reader shall have the same number configuration as the metering device itself, and read in cubic feet. All wires to the remote reader shall be enclosed in a heavy plastic or rigid metal conduit. All wiring shall be in conformance with appropriate sections of the *National Electric Code*.

620 Inspection of Water Lines and Appurtenances

In order to ensure the proper, safe installation of approved water mains and services (including the corporation stop, service line, curb stop or meter valves, their connections

and all other service components) and associated water system appurtenances in a project that is under construction, and to minimize the loss of water from the system through leakage, the City Engineer may require inspections of water main pipes, water services, water fittings (*e.g.*, a bend or tee) and appurtenances (*e.g.*, a fire hydrant or valve) on a random basis, in addition to the inspections required by Section 150.2, and may require the Contractor to uncover water system components previously backfilled by the Contractor prior to such inspections. Such additional inspections shall continue until the City Engineer has evidence to reasonably conclude that the components are of approved material, properly installed and in good working order, safe for public use.